Space Weather Technical Forecast

Issued on Tuesday 11 March 2025 at 13:06 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of isolated M-class flares. G1/Minor Storms likely by Days 3-4 (13-14 Mar), chance G2/Moderate Storms. Active fluence expected.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low with only isolated C-class flares observed. There are currently eight regions on the Earth-facing disc. The main region of interest continues to be AR4019 in the northeast, which has seen gradual growth in its trailer and intermediate regions, and continues with a weak delta spot. AR4012 in the southwest has shown a decrease in size, with the northern umbra breaking up into smaller spots. Newly numbered AR4024, situated in the northwest, has a small penumbra but with mixed polarities within this area, so it is a very weak delta spot. AR4021 in the southeast has seen a number of spots develop ahead of its largest spot in recent hours, now classified as a beta group. The remaining regions are relatively small and simple at the present time.

No Earth-directed CMEs have been observed.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE at L1, showed a declining connection to the fast wind of CH21/-. Wind speeds were initially strong near 600km/s, declining to slightly elevated levels near 450km/s. Density was mostly below average. Interplanetary Magnetic Field, Bt, was weak at 6nT or below. The north-south component, Bz, was weakly variable between +/-6nT. Phi angle was predominantly negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled (Kp1-3).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 was at background levels. High energy electron flux (greater than 2 MeV) reached high levels at the diurnal max, recording a max of 2400 pfu at 10/1620 UTC. The 24-hour fluence reached the Active threshold (1e8 integrated pfu) at 11/1200 UTC, continuing on a rising trend, with 7.98e7 integrated pfu observed at 11/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low activity is most likely, but with a slightly increasing chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: There are no CMEs likely to impact Earth, however a weak glance cannot be completely ruled out on Day 1 (11 Mar). Ongoing fast winds are expected to

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continue to ease through Days 1-2 (11-12 Mar), likely reaching background levels. The next fast wind enhancement is most likely to occur during Day 3 (13 Mar), with elevated to strong wind speeds expected.

Geomagnetic activity is expected to be Quiet to Unsettled through Days 1 and 2, with a decreasing chance of isolated Active intervals. On Days 3 and 4 a spell of Active to G1/Minor Storms are likely, with the potential for isolated G2/Moderate storm intervals.

Energetic Particles / Solar Radiation: High energy proton flux is most likely to remain at background levels. High energy electron flux is expected to reach high levels at the diurnal peaks on Days 1-2 (11-12 Mar), perhaps dropping Days 3-4 (13-14 Mar). The associated 24 hour fluence is expected to stay above Active Days 1-2, potentially declining Days 3-4.

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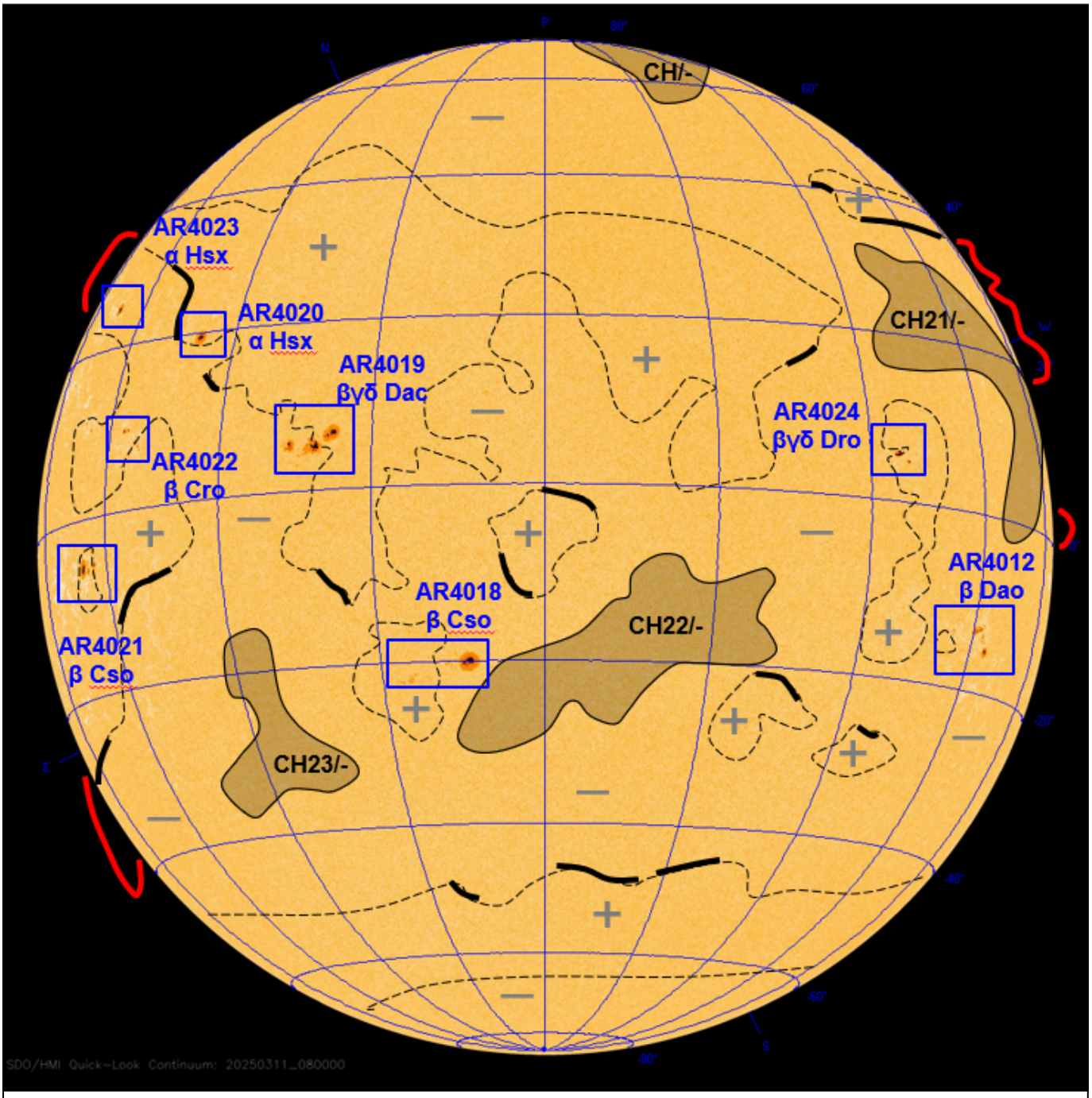
Figure 1: Solar Synoptic Map valid 11/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There are no CMEs likely to impact Earth, however the CME from the M1.6-flare around 07/2100 UTC is expected to pass close, to the south, and a weak glance cannot be completely ruled out on Day 1 (11 Mar).

Ongoing fast winds from CH21/- have been easing through the last 24/36 hours, with this expected to continue through Days 1-2 (11-12 Mar), likely reaching background levels. The next coronal hole fast wind enhancement, from CH22/-, is most likely to occur during Day 3 (13 Mar). MOSWOC Enlil is suggesting this may occur on Day 2, but Enlil is considered too fast with this enhancement. Whilst both coronal holes were present on the previous rotation, a narrow link between them now appears to have closed. This means that persistence from the previous rotation is less useful, with wind speeds likely to fall lower than previously in the gap between the CHs. That said, the leading edge of CH22 appears to be in a similar location to the main part of the CH on the previous rotation, and a similar onset of elevated to strong wind speeds is likely. This is a negative polarity coronal hole, which is favoured for connection to Earth at this time of year.

Geomagnetic activity is expected to be Quiet to Unsettled through Days 1 and 2, with a decreasing chance of isolated Active intervals. On Days 3 and 4 a spell of Active to G1/Minor Storms are likely, with the potential for isolated G2/Moderate storm intervals.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	30	70	70
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
08/0050	Partial	AR4016	34S 06E	825	Missing	Small chance of weak, glancing arrival 11 Mar.

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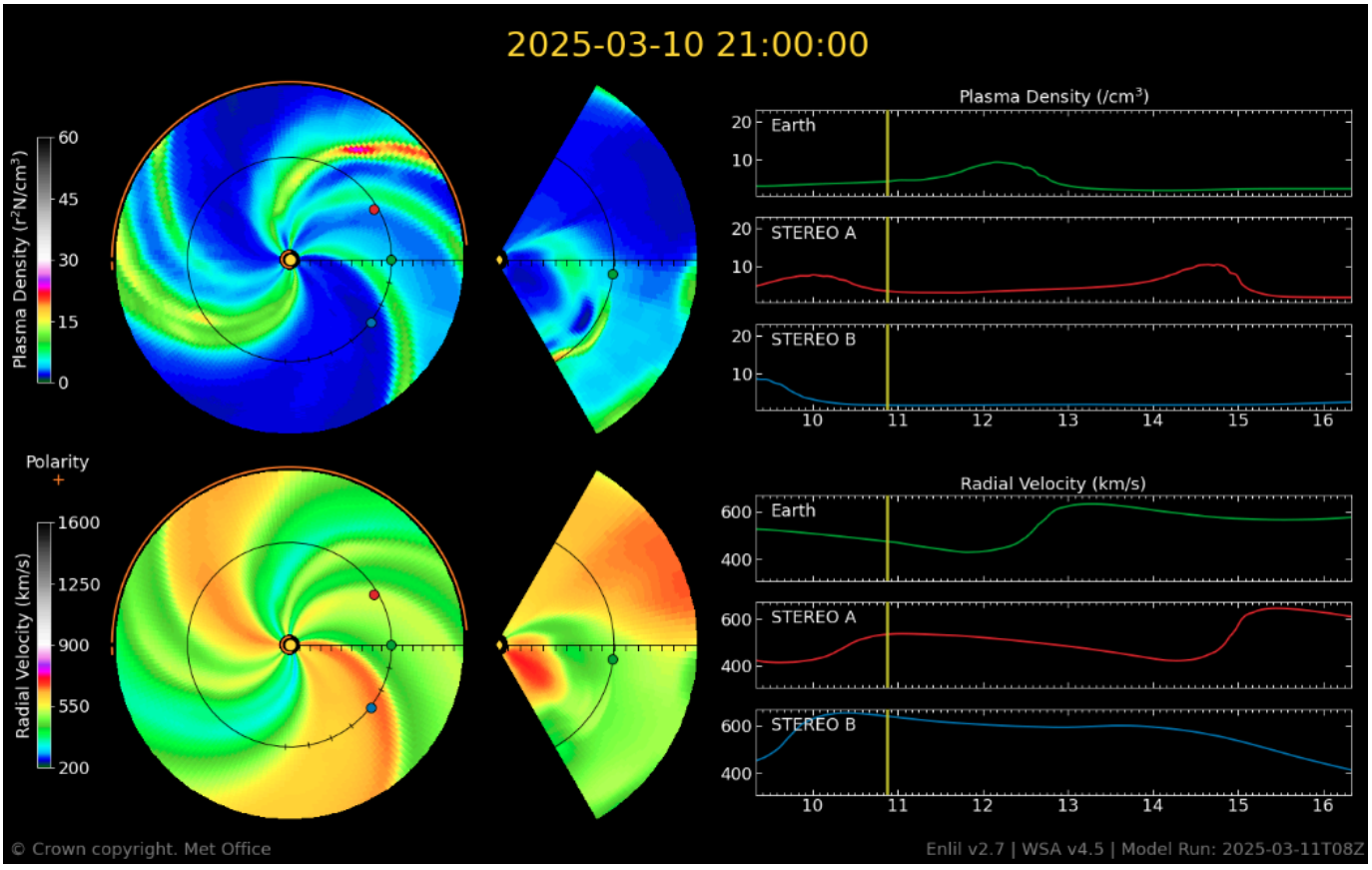
Figure 2: MOSWOC Enlil, showing bulk of CME passing south of Earths orbit, with only a slight glance possible. Note the connection to CH21/- is likely a touch early.



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Radio Blackouts - X-Ray Flares

Solar activity has been Low with only isolated C-class flares observed.

There are currently eight regions on the Earth-facing disc. The main region of interest continues to be AR4019 in the northeast, which has seen gradual growth in its trailer and intermediate regions, and continues with a weak delta spot. AR4018 is just about holding onto some weak trailing spots. AR4012 in the southwest has shown a decrease in size, with the northern umbra breaking up into smaller spots. Newly numbered AR4024, situated in the northwest, has a small penumbra but with mixed polarities within this area, so it is a very weak delta spot. AR4021 in the southeast has seen a number of spots develop ahead of its largest spot in recent hours, now classified as a beta group. Newly numbered AR4022, situated in the northeast, does not currently possess any mature penumbra, but it remains rather close to the limb for a full assessment. An area of plage to the east of this region may have another couple of small spot regions developing within it, but they are currently not included in this analysis. The remaining regions are relatively small and simple at the present time.

There are several ex-sunspot regions which may return over the east limb during this period, with some looping showing in SDO imagery to support this. However, the potential activity levels of any new regions cannot be assessed until they appear on the visible disc. Low activity is most likely, but with a slightly increasing chance of isolated M-class flares.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**R1-R2 (M Class)**	No	40	45	50	50
Very Active	**R3-R5 (X Class)**	No	5	5	5	5

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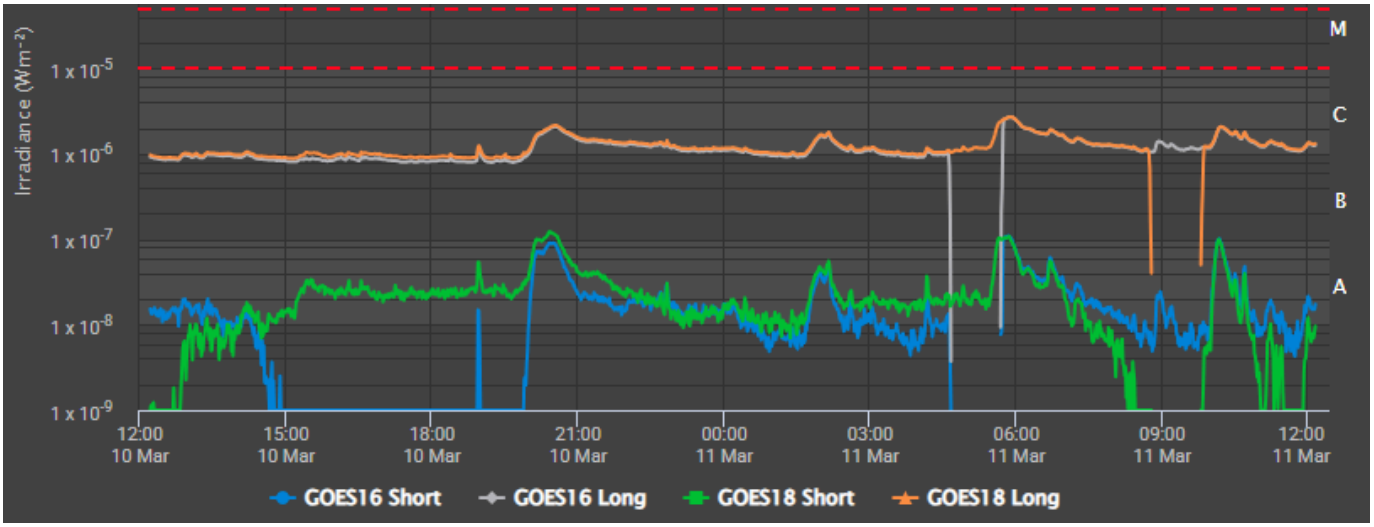
Figure 3: GOES-16 & -18 X-ray flux.



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Solar Radiation Storms (High Energy Protons)

GOES18 high energy (>10MeV) proton flux is likely to persist at background levels, with the current regions on the disc not significantly complex, which means the risk of them producing proton enhancements is low. That said, the majority of the sunspot regions are in the east of the visible disc and there is a very slightly increasing risk as these regions rotate westward into a better connected position with respect to Earth.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	2	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

The high-energy electron flux (>2MeV) observed at GOES16 reached high levels on 10 Mar at the diurnal maximum, as solar winds are now easing from the recent fast wind connection. Electron flux has become high already on Day 1 (11 Mar), and is likely to again on Day 2 (12 Mar), perhaps for longer and with a higher peak. After this, confidence is low for the longevity of this high flux due to the potential fast wind from CH22/- expected on Days 3 and 4 (13-14 Mar), along with the very slight chance of a CME glance early on Day 1 (11 Mar), providing the potential for drop out of the observed flux at GEO. Once the next fast wind is established however, there is a renewed risk of high flux levels later in the period, although this is more likely after the end of this period.

The associated 24 hour integrated fluence is currently rising and rose above the Active (1e8 integrated pfu) threshold at 11/1200 UTC, and is expected to remain above through Days 1 and 2, before potentially showing a declining trend into Days 3 and 4. Both 27-day recurrence and MOSWOC REFM are currently giving reasonable guidance for the rising trend, although this is perhaps underestimating the time spent above the active fluence threshold.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	100	80	60	40
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 4: GOES-16 Electron flux.

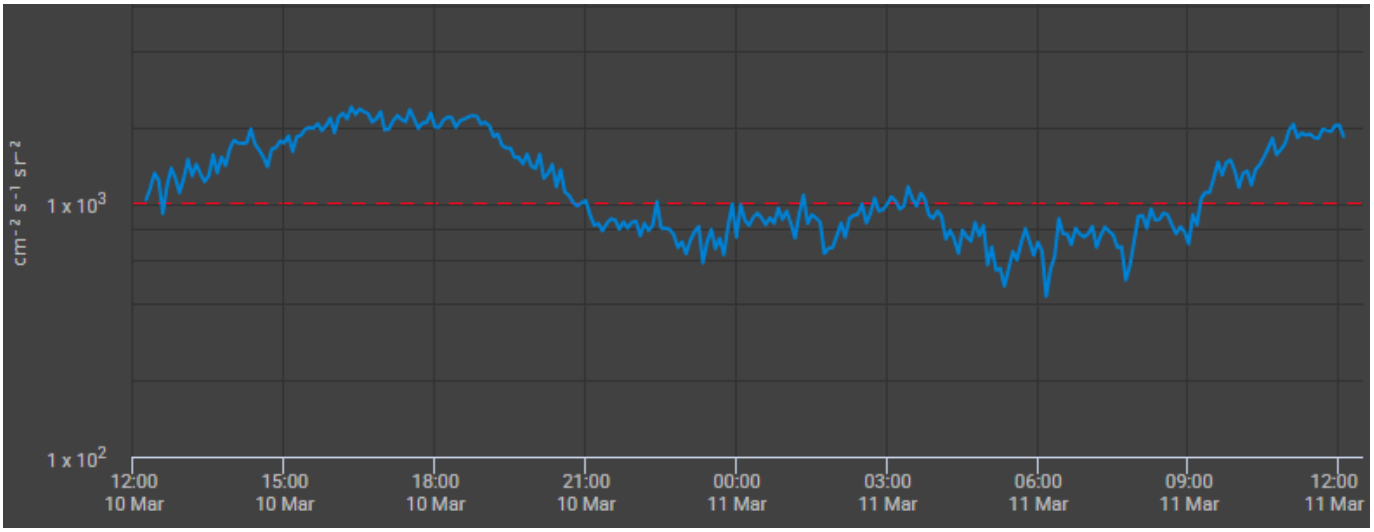

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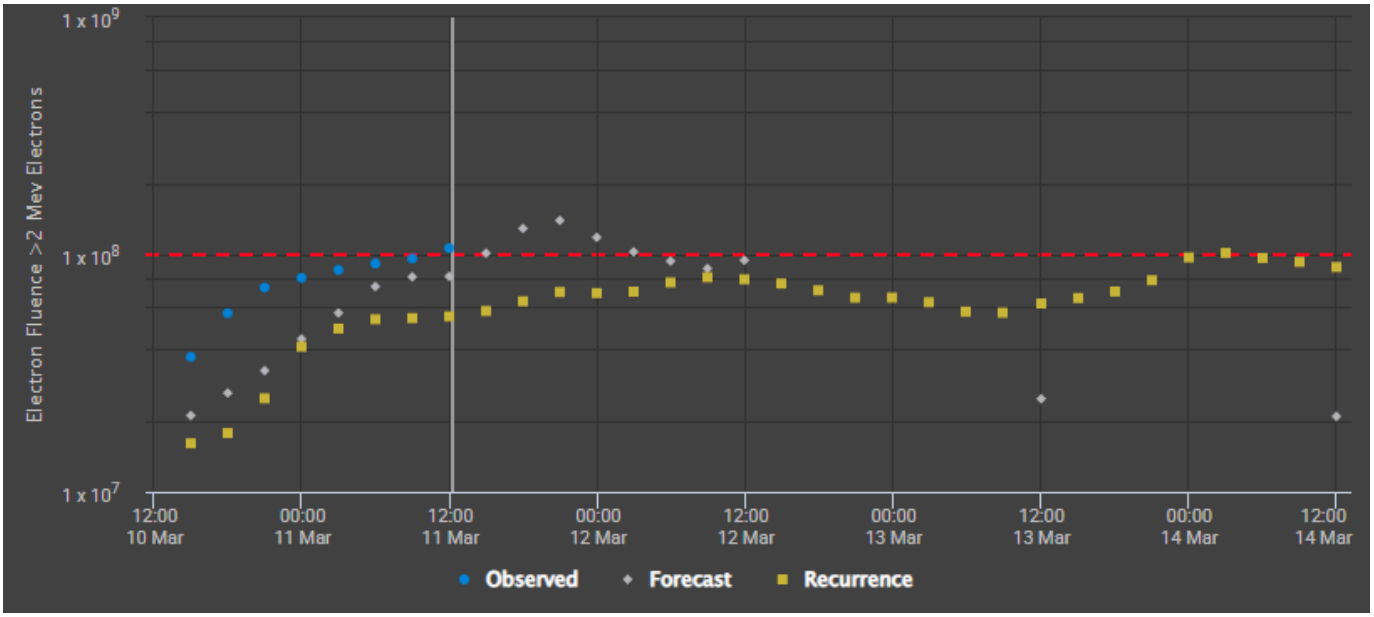
Figure 5: MOSWOC REFM



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